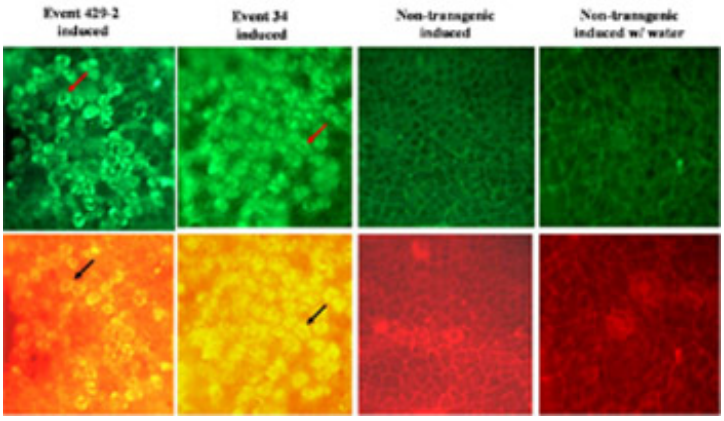
NSF Highlights

Feedstock Chemicals from Trees for Bioplastics Production

Highlight ID: 15209

The Industry University Cooperative Research Center (I/UCRC) for Advanced Forestry Systems is turning trees into biorefineries. The center developed genetic systems that use trees to produce high value chemicals other then those normally derived from biomass. Their focus is on poplar, which is a leading candidate woody species for a biofuel/biomatierial crop system. The worldwide market for plastics is about $300-$500 billion per year.

The initial effort used induction (genetic engineering that turns on and off selected genes) to produce the biopolymer polydroxybutyrate (PHB). PHB is is a biodegradable polyester that is widely used as a feedstock for many types of plastics. Natural polyesters include cutin of plant cuticles and common synthetic polyesters such as the polycarbonate that is used in plastic bottles. Using trees to produce polyester would require little energy and the product would be biodegradable. These are substantial environmental benefits, In addition, plastics production by trees would help to partially offset the production of plastic derived from fossil fuels, and the associated production of greenhouses gases.



Staining with Nile A to reveal PHB agglomerations (arrows) after ecdysone induction in transgenic poplar.

Permission Granted
Credit: Cathleen Ma and Elizabeth Etherington, Oregon State University

The researchers recently experimented with the production of a version of PHB induced by the application of ecdysone or chemical analogs that are commercially used in agriculture. They discovered that about half of the transgenic poplars tested had a functional ecdyson switch; production of PHB could be readily detected using epiflourescence methods. The researchers demonstrated that that plant derived plastics can provide a substitute for petroleum-based sources.

Primary Strategic Outcome Goal:

- Disciplinary/Interdisciplinary Research (Anything not covered by one of the 12 categories below.)

Secondary Strategic Outcome Goals:

- Graduate Education

How does this highlight address the strategic outcome goal(s) as described in the NSF Strategic Plan 2006-2011?:
The work demonstrated by this project aligns with NSF's goal for discovery.

Does this highlight represent transformative research? *If so, please explain why.*
The National Science Board has defined transformative research as "Research that has the capacity to revolutionize existing fields, create new subfields, cause paradigm shifts, support discovery, and lead to radically new technologies." National Science Board: Enhancing Support of Transformative Research at the National Science Foundation

Yes

The use of trees to produce plastic feedstocks for greater yields is novel. Past efforts were limited to small plants.

Does this highlight represent Broadening Participation? *If so, please explain why.*
The concept of broadening participation includes: individuals from underrepresented groups, certain types of institutions of higher education, geographic areas (e.g. EPSCoR states), and organizations whose memberships are composed of institutions or individuals underrepresented in STEM or whose primary focus is on broadening participation in science and engineering. It is important to note that underrepresented groups vary within scientific fields.

No

Are there any existing or potential societal benefits, including benefits to the U.S. economy, of this research of which you are aware? *If so, please describe in the space below.*
It is important for NSF to be able to provide examples of NSF-supported research that have or may have societal benefits.

Yes

The research may provide an approach to "green" production of plastics on a larger scale.

ENG/IIP 2008

Program Officer: Glenn Larsen

NSF Award Numbers:

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Award Title: Collaborative Research: Center for Advanced Forestry Systems
PI Name: Glenn Howe

Institution Name: Oregon State University

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NSF Contract Numbers:

NSF Investments: American Competitiveness Initiative (ACI), Climate Change, Environment (including the importance of fresh water supplies), Understanding Complex Biological Systems (including the interfaces of life, physical, and computational sciences)

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